

## LONG TERM NITROGEN FERTILITY STUDIES

Two long-term nitrogen fertility studies were evaluated in 1986. Treatments for these studies are outlined in Table 11 and data shown in Tables 12 and 13. These studies evaluate nitrogen fertility programs comparing carriers, rates and frequencies. These studies have been set up cooperatively with J.M. Vargas, Jr., and the first has been conducted on a Penncross creeping bentgrass green at the Hancock Turfgrass Research Center. Turfgrass Quality ratings data are given in Table 12. Results are about as expected from these treatments. Late fall applications of nitrogen (treatments 1,3,5,7,9 and 11) give better spring color. The 18-4-10 is provided by the Lebanon Chemical Co. and is used as representative complete fertilizer containing some slow release nitrogen. In May 1986 a spotty response was noted to the application of urea, ammonium nitrate and sulfur coated urea. This has been observed in the past. In all other studies with urea or ammonium nitrate we have found it necessary to apply these materials as a spray to prevent this spotty response which occurs in spite of watering immediately after application. The spottiness is caused by a high concentration of soluble nitrogen being released around the fertilizer granular giving greener spots on the greens. This is seen occasionally of annual bluegrass fairway height turf but has not been observed on turfs which are mowed higher.

The residual effects of the treatments outlined in Table 11 are given in Table 13. The study was discontinued in 1986 but some residual data were taken. The most striking response was the dramatically higher incidence of annual bluegrass seedheads for certain fertility treatments. The higher the nitrogen rate the more seedheads developed. Compare treatments 16 through 20 with rates of nitrogen ranging from 1.0 to 7.5 pounds N per 1000 square annually. Of further interest is the tendency for late fall N applications of certain carriers to result in more seedheads.

Another long term study is the effect of nine different nitrogen fertility programs on three creeping bentgrasses, Emeralds, Penncross and Penneagle. Treatments applied to these turfs which were maintained under greens conditions are given in Table 14. Turfgrass quality ratings are given in Tables 15 through 17 for the three grasses while color ratings are given in Tables 18 through 20. Responses are as would be expected from these treatments. This study will be terminated in 1987.

Table 11. Treatments applied on a Penncross bentgrass green and on annual bluegrass in a fairway nitrogen carrier fertility study at the Hancock Turfgrass Research Center. Treatments initiated in 1982 and revised in 1985. Plot size is 6 feet by 6 feet. Four replications.

No.	<u>Treatment</u> N Carrier	<u>Month of application</u>							Total
		Nov	Apr	May	June	July	Aug	Sept	
- - - - - Pounds N per 1000 sq. ft. - - - - -									
1	IBDU	1.0	---	---	0.5	0.5	0.5	1.0	3.5
2	IBDU	---	1.0	1.0	1.0	---	---	1.0	4.0
3	S.C. Urea	1.0	---	---	0.5	0.5	0.5	1.0	3.5
4	S.C. Urea	---	1.0	1.0	1.0	---	---	1.0	4.0
5	Urea	1.0	---	---	0.5	0.5	0.5	1.0	3.5
6	Urea	---	1.0	1.0	1.0	---	---	1.0	4.0
7	Am. Nitrate	1.0	---	---	0.5	0.5	0.5	1.0	3.5
8	Am. Nitrate	---	1.0	1.0	1.0	---	---	1.0	4.0
9	Milorganite	1.0	---	---	0.5	0.5	0.5	1.0	3.5
10	Milorganite	---	1.0	1.0	1.0	---	---	1.0	4.0
11	18-4-10	1.0	---	---	0.5	0.5	0.5	1.0	3.5
12	18-4-10	---	1.0	1.0	1.0	---	---	1.0	4.0
13	18-4-10	---	---	1.0	---	---	---	1.0	2.0
14	18-4-10	---	0.5	1.0	0.5	0.5	0.5	1.0	4.0
15	18-4-10	---	1.0	1.0	1.0	1.0	1.0	1.0	6.0
16	Urea	---	---	0.5	---	---	---	0.5	1.0
17	Urea	---	---	1.0	---	---	---	1.0	2.0
18	Urea	---	0.5	1.0	0.5	0.5	0.5	1.0	4.0
19	Urea	---	1.0	1.0	1.0	1.0	1.0	1.0	6.0
20	Urea	---	1.5	1.5	1.0	1.0	1.0	1.5	7.5

Table 12. Effect of long term nitrogen carrier fertility study on turfgrass quality ratings of Penncross creeping bentgrass. Treatments described in Table 11. Hancock Turfgrass Research Center. Averages of 4 replications.

Treatment No.	Visual turfgrass quality rating (9 = best)								
	5/12	6/5	6/12	6/24	7/8	8/7	9/9	9/19	10/16
1	6.0 bd	7.3 ab	5.4 gh	5.4 gh	5.6 fg	6.4 eg	7.0 de	7.1 e	7.9 a
2	5.0 dg	6.9 ac	7.4 be	5.6 be	7.4 bd	6.6 df	6.5 ef	6.1 fg	7.5 cd
3	6.6 ac	6.0 be	5.4 gh	5.3 h	5.6 fg	6.8 df	6.1 fg	5.9 fh	8.0 bc
4	4.6 eg	5.4 df	6.0 fh	6.1 fh	6.9 ce	6.9 df	5.1 i	5.5 gh	7.5 cd
5	6.9 ab	6.5 ad	5.3 gh	5.5 h	7.0 cd	8.0 ad	7.8 bc	7.8 cd	8.0 bc
6	5.4 cf	6.5 ad	8.5 ab	8.3 ac	8.5 a	7.0 bf	5.4 hi	5.6 gh	8.3 ab
7	7.5 a	7.1 ac	5.1 h	5.5 gh	6.4 dh	7.9 ac	7.8 bc	7.5 de	8.5 ab
8	5.4 cf	7.0 ac	7.9 ac	7.8 ad	8.3 ab	7.3 ae	5.0 i	5.3 hi	8.4 ab
9	4.8 dg	6.5 ad	6.5 dg	6.6 df	5.6 fg	7.1 af	6.4 eg	6.1 fg	8.0 bc
10	4.6 eg	6.5 ad	7.0 cf	7.5 ce	6.9 cd	7.1 af	6.0 fh	5.9 fh	7.3 cd
11	6.0 bd	5.8 cd	5.1 h	5.4 gh	5.4 fg	6.1 fg	5.8 gh	5.6 gh	7.4 cd
12	6.8 ab	6.9 ac	6.3 eh	6.9 df	7.4 bd	6.8 df	5.4 hi	5.4 gi	7.4 cd
13	4.5 fg	4.9 ef	6.0 fh	6.9 df	6.3 eg	5.6 g	4.9 i	4.8 ij	7.1 d
14	5.9 be	6.3 ed	6.6 cg	7.4 ce	7.5 ac	6.9 cf	6.5 ef	6.4 f	7.5 cd
15	6.6 ac	7.5 a	7.8 ad	7.5 ce	7.6 ac	8.1 a	7.4 cd	8.3 ac	7.8 bd
16	4.6 eg	4.9 ef	5.5 gh	6.4 fh	5.3 g	5.5 g	4.8 i	4.1 k	7.1 d
17	4.0 g	4.6 f	5.1 h	7.8 ad	6.0 eg	5.5 g	4.8 i	4.4 ik	7.9 bc
18	4.6 eg	6.9 ac	8.9 a	8.4 ab	8.4 ab	7.6 ad	8.4 ab	8.1 bd	8.5 ab
19	6.1 bd	7.3 ab	8.8 a	8.6 ad	8.5 a	8.1 a	8.5 a	8.8 a	8.8 a
20	6.9 ab	7.6 a	8.6 ab	8.8 a	8.4 ab	7.6 ad	8.4 ab	8.5 ab	8.3 ab

Table 13. Effect of residual nitrogen carrier fertility treatments as outlined in Table 11 on visual turf quality ratings and relative seedhead production of annual bluegrass. Hancock Turfgrass Research Center. Averages of 4 replications.

<u>Treatment</u>		<u>Quality rating (9=best)</u>	<u>Relative seedheads (9=most)</u>
No.	N Carrier	Apr 4	May 16
1	IBDU	2.8 ce	4.6 bf
2	IBDU	2.3 ef	6.6 gi
3	S. coated urea	3.4 ac	4.6 bf
4	S. coated urea	2.1 ef	6.1 fh
5	urea	3.9 a	5.0 bf
6	urea	2.1 ef	5.8 eg
7	ammonium nitrate	3.6 ab	4.4 bf
8	ammonium nitrate	2.3 ef	4.1 be
9	milorganite	3.1 d	3.5 bc
10	milorganite	2.1 ef	4.4 bf
11	18-4-10	3.3 ac	4.5 bf
12	18-4-10	2.4 ef	4.0 bc
13	18-4-10	2.5 df	2.9 ab
14	18-4-10	2.3 ef	3.4 ac
15	18-4-10	2.0 f	5.4 dg
16	urea	2.8 ce	1.9 a
17	urea	2.6 df	4.4 bf
18	urea	2.3 ef	5.3 dg
19	urea	2.3 ef	7.4 hi
20	urea	2.5 df	7.9 i

Table 14. Long-term nitrogen fertility program treatments which have been applied to Penncross, Penneagle or Emerald creeping bentgrass turfs mowed at 3/16 inch. Treatments initiated in 1982. All plots receive 2 pounds  $K_2O$  per 1000 sq. ft. annually. Hancock Turfgrass Research Center. Averages of 3 replications.

No.	Treatment		Month of application						
	Carrier	N rate lbs/1000	Apr	May	June	July	Aug	Sept	Nov
1	Urea	1	-	0.5	-	-	-	0.5	-
2	Urea	2	-	1.0	-	-	-	1.0	-
3	Urea	3	-	1.0	0.5	0.5	-	1.0	-
4	Urea	4	-	1.0	1.0	-	1.0	1.0	-
5	Urea	6	1.0	1.0	1.0	1.0	1.0	1.0	-
6	Urea	8	1.25	1.25	1.25	1.25	1.25	1.25	-
7	Urea	4	-	-	1.0	0.5	-	1.0	1.5
8	Milorganite	4	-	-	1.0	0.5	-	1.0	1.5
9	Ammonium nitrate	4	-	1.0	1.0	1.0	-	1.0	-

Table 15. Effect of long-term nitrogen fertility program on turfgrass visual quality rating of Emerald creeping bentgrass mowed at 3/16 inch. Hancock Turfgrass Research Center. Treatments initiated in 1982. See Table 14 for description of treatments. Averages of 3 replications.

No.	Treatment N Rates lbs/1000	Turfgrass Quality Rating (9 = best)								
		5/14	6/5	6/12	6/24	7/7	8/7	9/9	9/18	10/16
1	1	4.0 c	4.2 d	5.7 de	6.3 cd	4.0 c	4.0 d	4.8 d	4.5 e	7.5 a
2	2	4.5 c	4.3 d	7.2 bc	7.2 bc	5.8 ac	5.0 cd	4.7 d	4.5 e	7.8 a
3	3	4.3 c	4.2 d	8.0 ab	7.2 bc	7.3 ab	8.0 a	5.5 c	5.2 de	8.3 a
4	4	4.5 c	5.0 c	8.0 ab	7.5 ab	7.2 ab	6.3 bc	8.2 a	7.5 b	8.7 a
5	6	5.8 b	6.3 ab	8.7 a	8.3 a	7.5 ab	8.2 a	8.5 a	8.7 a	8.3 a
6	8	6.8 a	6.7 a	8.5 a	8.3 a	7.7 a	8.2 a	8.5 a	8.2 ab	8.3 a
7	4	5.7 b	5.8 b	5.0 e	5.5 d	7.3 ab	8.8 a	6.2 b	6.3 c	8.8 a
8	4	5.2 b	6.5 a	6.5 cd	6.0 d	5.8 ac	7.3 ab	5.8 bc	5.7 d	7.5 a
9	4	4.5 c	5.0 c	7.7 ab	8.0 ab	5.5 bc	8.0 a	5.7 bc	5.8 cd	7.5 a

Table 16. Effect of long-term nitrogen fertility program on turfgrass visual quality ratings of Penncross creeping bentgrass turf mowed at 3/16 inch. Hancock Turfgrass Research Center. Averages of 3 replications. See Table 14 for description of treatments.

Treatment No.	N Rate lbs/1000	Turfgrass Quality Rating (9 = best)								
		5/14	6/5	6/12	6/24	7/7	8/7	9/9	9/18	10/16
1	1	3.0 a	4.2 c	7.3 b	6.0 c	4.0 c	4.2 c	5.0 e	4.7 e	7.5 c
2	2	3.0 d	4.3 c	8.5 ab	7.8 ab	4.7 c	4.3 c	5.0 e	5.0 de	7.7 bc
3	3	3.3 d	4.7 c	8.3 ab	7.5 b	6.7 b	6.7 ab	5.8 de	5.5 de	8.3 ab
4	4	3.5 d	4.3 c	8.7 a	7.5 b	7.7 ab	5.7 bc	8.2 ab	7.7 b	8.3 ab
5	6	6.0 b	6.2 b	8.8 a	8.7 a	8.5 a	8.0 a	8.8 a	8.8 a	8.7 a
6	8	6.8 a	6.0 b	8.7 a	8.7 a	8.8 a	7.8 a	8.8 a	8.8 a	9.0 a
7	4	6.8 a	7.2 a	5.5 c	6.3 c	6.8 b	7.7 a	6.5 cd	6.5 c	8.7 a
8	4	4.8 c	7.5 a	7.3 b	7.5 b	5.0 c	5.7 bc	5.5 de	5.8 cd	7.2 c
9	4	3.2 d	4.5 c	8.3 ab	7.3 b	7.5 ab	7.7 a	7.2 bc	6.7 c	8.5 a

Table 17. Effect of long-term nitrogen fertility program on visual turfgrass quality rating of Penneagle creeping bentgrass mowed at 3/16 inch. Hancock Turfgrass Research Center. Treatments initiated in 1982. See Table 14 for description of treatments. Averages of 3 replications.

No.	Treatment N Rate lbs/1000	Turfgrass Quality Rating (9 = best)								
		5/14	6/5	6/12	6/24	7/7	8/7	9/9	9/18	10/16
1	1	4.0 e	4.7 e	5.5 d	6.0 e	4.0 d	4.3 c	5.0 c	5.0 e	7.3 a
2	2	4.2 de	4.5 e	8.0 c	7.7 c	5.3 c	4.8 c	6.8 ab	6.7 bd	8.5 a
3	3	4.8 cd	5.3 de	8.2 bc	7.7 c	7.0 b	8.2 a	5.8 bc	5.5 de	8.7 a
4	4	5.0 c	5.8 cd	8.5 ab	8.2 bc	7.3 b	6.2 b	7.0 ab	7.5 ab	8.0 a
5	6	6.2 b	7.0 ab	8.8 a	9.0 a	7.5 ab	8.0 a	8.0 a	8.5 a	8.3 a
6	8	7.0 a	7.0 ab	8.7 a	8.8 ab	8.0 a	8.0 a	8.2 a	8.7 a	7.7 a
7	4	6.0 b	6.7 bc	5.5 d	6.2 de	8.0 a	8.5 a	8.3 a	8.8 a	8.2 a
8	4	5.3 c	7.8 a	5.8 d	6.8 d	5.7 c	6.5 b	6.0 ab	5.8 ce	8.3 a
9	4	5.2 c	5.7 d	8.3 bc	8.0 c	7.2 b	7.8 a	6.8 ab	7.3 ac	8.3 a



Table 18. Effect of long-term nitrogen fertility program on turfgrass color rating of Emerald creeping bentgrass turf mowed at 3/16 inch. Hancock Turfgrass Research Center. Treatments initiated in 1982. See Table 14 for description of treatments. Averages of 3 replications.

Treatment No.	N Rate lbs/1000	Turf Color Rating (9 = dark green)								
		4/14	5/14	6/5	6/12	7/7	8/7	9/9	9/18	10/16
1	1	2.0 d	4.0 c	4.0 f	7.0 b	4.3 d	4.5 e	5.3 c	5.0 d	7.5 bc
2	2	2.3 cd	4.0 c	4.2 ef	8.2 a	5.7 bc	5.0 de	5.2 c	4.8 d	7.8 ac
3	3	2.0 d	4.2 c	4.2 ef	8.2 a	6.8 ac	7.7 ab	5.8 bc	5.8 c	8.0 ac
4	4	3.0 bc	4.2 c	4.3 ef	8.5 a	7.0 ab	6.2 cd	7.7 a	7.0 b	7.8 ac
5	6	2.8 bc	6.0 b	5.5 bc	8.8 a	7.3 a	7.7 ab	8.2 a	7.7 a	8.2 ab
6	8	3.0 bc	6.5 a	6.2 a	8.8 a	7.2 a	7.8 ab	8.2 a	8.0 a	7.8 ac
7	4	6.8 a	5.7 b	5.0 cd	5.5 c	7.5 a	8.5 a	6.2 b	6.0 c	8.5 a
8	4	3.3 b	5.2 c	6.0 ab	7.0 b	5.8 bc	6.8 bc	5.8 bc	5.8 c	7.3 c
9	4	2.8 c	4.7 d	4.8 de	8.3 a	5.5 cd	7.5 ac	6.2 b	5.7 c	7.5 bc

Table 19. Effect of long-term nitrogen fertility program on turfgrass color ratings of Penncross creeping bentgrass turf mowed at 3/16 inch. Hancock Turfgrass Research Center. See Table 14 for description of treatments. Averages of 3 replications.

No.	<u>Treatment</u>	<u>Turf Color Rating (9 = dark green)</u>								
	<u>N Rate</u> lbs/1000	4/4	5/14	6/5	6/12	7/7	8/7	9/9	9/18	10/16
1	1	2.0 d	4.3 c	4.5 c	7.8 b	4.3 d	4.3 d	5.2 e	5.2 c	7.7 b
2	2	2.5 cd	5.0 bc	4.7 c	8.8 a	5.7 c	4.7 d	5.3 e	5.3 c	8.3 ab
3	3	2.3 d	4.7 bc	4.5 c	8.3 ab	7.3 ab	6.8 bc	6.0 d	6.3 b	8.3 ab
4	4	3.0 bc	4.8 bc	4.8 c	8.8 a	8.0 a	5.5 cd	8.0 b	8.7 a	8.3 ab
5	6	3.5 b	7.3 a	6.2 b	9.0 a	8.5 a	8.7 a	8.5 ab	8.8 a	8.8 a
6	8	3.5 b	7.5 a	6.3 b	9.0 a	8.3 a	8.3 ab	8.8 a	8.7 a	8.7 ab
7	4	6.3 a	7.3 a	6.7 b	6.5 c	6.5 bc	8.3 ab	6.7 a	6.8 b	8.8 a
8	4	3.5 b	5.3 b	7.8 a	7.7 b	6.0 bc	5.7 cd	6.0 d	6.7 b	7.7 b
9	4	3.0 bc	4.8 bc	4.8 c	8.3 ab	8.0 a	8.3 ab	7.0 c	7.0 b	8.7 ab

Table 20. Effect of long-term nitrogen fertility program on turfgrass color ratings of Penneagle creeping bentgrass mowed at 3/16 inch. Hancock Turfgrass Research Center. Treatments initiated in 1982. Hancock Turfgrass Research Center. See Table 14 for description of treatments. Averages of 3 replications.

No.	<u>Treatment</u>	<u>Turf Color Rating (9 = dark green)</u>								
	<u>N Rate</u> lbs/1000	4/4	5/14	6/5	6/12	7/7	8/7	9/9	9/18	10/16
1	1	2.0 d	4.0 ef	4.5 e	6.8 c	4.0 c	5.2 e	5.5 d	5.2 c	7.7 b
2	2	2.0 d	3.8 f	4.7 de	8.7 a	5.2 b	4.7 e	6.5 cd	5.3 c	8.3 ab
3	3	2.5 d	3.7 f	4.8 de	8.7 a	7.2 a	7.5 c	5.7 d	6.3 b	8.3 ab
4	4	2.7 cd	4.5 de	5.3 cd	8.8 a	7.5 a	6.0 d	7.2 ac	8.7 a	8.3 ab
5	6	3.3 bc	6.3 b	6.3 b	9.0 a	7.5 a	8.0 bc	7.2 ac	8.8 a	8.8 a
6	8	3.5 b	7.7 a	7.0 a	9.0 a	7.3 a	8.3 ab	8.2 a	8.7 a	8.7 ab
7	4	7.0 a	6.5 b	5.8 bc	5.8 d	7.7 a	8.7 a	8.0 ab	6.8 b	8.8 a
8	4	3.3 bc	5.3 c	7.0 a	7.5 b	5.8 b	6.5 d	5.8 d	6.7 b	7.7 b
9	4	2.5 d	4.8 cd	5.0 de	8.8 a	7.0 a	8.3 ab	6.8 bd	7.0 b	8.7 ab